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EXAMINER	
THOMAS, MIA M	

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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)	
	10/522,027	SUGENO ET AL.	
	Examiner	Art Unit	
	Mia M. Thomas	2624	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☐ Responsive to communication(s) filed on _____.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) 1-11 is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) 1-11 is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on 21 January 2005 is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☒ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date see attached.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Priority

1. Receipt is acknowledged of papers submitted under 35 U.S.C. 119(a)-(d), which papers have been placed of record in the file.

Specification

2. The title of the invention is not descriptive. A new title is required that is clearly indicative of the invention to which the claims are directed.

The following title is suggested: " Edge Preservation Type Image Processing Device" or "Recursive Filtering Image Processing Device for Improving an Image Representing Small Objects".

Claim Rejections - 35 USC § 102

3. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (a) the invention was known or used by others in this country, or patented or described in a printed publication in this or a foreign country, before the invention thereof by the applicant for a patent.
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.
>
> (e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

4. Claims 1-3, 6, and 10 are rejected under 35 U.S.C. 102(e) as being anticipated by Tsuchiya et al (US 6,724,943 B2).

Regarding Claim 1:

Tsuchiya discloses an image processing device ("This invention relates to a device and a method for image processing..." at column 1, line 13), comprising:

recursive filtering means of smoothing an input image (Refer to Figure 3);

and arithmetic means of subtracting an input image smoothed by the recursive filtering means from the original of the input image (Refer to Figure 2 and 3; "To put it concretely, the nonlinear smoother 5 inputs the input image data S1 to a linear low-pass filter 10, as shown in FIG. 2." At column 2, line 65; "The adder 40, which comprises an image enhancing means along with the adder 41 and a multiplier 42, subtracts each pixel value s(i, j) of the smoothed image data S11 from each pixel value x(i, j) of the delayed image data S15, and sends the resulted differential image data S16 to the multiplier 42." at column 6, line 4),

wherein the recursive filtering means includes: edge setting means of setting at least one edge having a predetermined angle from a scanning line direction of the input image ("The nonlinear smoother 5 extracts the edge components..." at column 2, line 58);

and control means of smoothing the image to be smoothed in correspondence with the edge set by the edge setting means ("...the pixel values of which change abruptly, out of this input image data S1, and outputs the edge components as it is without smoothing it, while smoothes the small-amplitude components other than the edge components, and hereby smoothes the input image data S1, conserving the edge components of the input image data S1." at column 2, line 59).

Regarding Claim 2: Tsuchiya discloses display means of displaying the input image ("The camera signal processing circuit 45 applies the stated data processing to the output image

data S18, and then sends and records the resulted output image data S19 onto a Video Tape Recorder (VTR) 46." at column 6, line 17; "In addition, in the above-mentioned embodiments, such aspects have been described that the present invention has been applied to video cameras 1, 50 and 60; however, the present invention is applicable not merely to such, but to the other wide variety of image processing devices, such as an electronics still camera, a printer, a display unit, and a computer." at column 11, line 45); and region of interest setting means of setting a region of interest in the input image displayed in the display means, wherein the edge setting means sets the edge on the basis of the region of interest set by the region of interest setting means ("The adder 41 adds each pixel value s(i, j) of the smoothed image data S11, which corresponds to the offset of subtraction by the adder 40, to each pixel value g(i, j).times.(x(i, j)-s(i, j)) of the differential image data S17 that is supplied from the multiplier 42, and then sends the resulted output image data S18 to a camera signal processing circuit 45. The camera signal processing circuit 45 applies the stated data processing to the output image data S18, and then sends and records the resulted output image data S19 onto a Video Tape Recorder (VTR) 46." at column 6, line 17).

Regarding Claim 3: Tsuchiya discloses low-frequency component compression means (Refer to Figure 2, numeral 10)of setting an amount of compression by which low-frequency components of the input image are compressed according to the smoothed image generated by the recursive filtering means (Further refer to Figure 2, numerals 12a-12n, 13 and 35) wherein the control means changes an output from the recursive filtering means on the basis of the compression amount set by the low-frequency component compression means ("In addition to this, by heightening the smoothing effect in, for instance, the dark region and/or the bright region of image, the look-up table 11 enables to control also the smoothing effect in accordance

with the pixel value, such as increasing the degree of enhancement by the image enhancement processing on the succeeding stages." at column 3, line 27).

Regarding Claim 6: Tsuchiya discloses wherein the recursive filtering means performs processing expressed by g(t)=k*f(t)+(1-k)g(t-1)

where g(t) is the output from the recursive filtering means (The nonlinear smoother 5 extracts the edge components, the pixel values of which change abruptly, out of this input image data S1, and outputs the edge components as it is without smoothing it, while smoothes the small-amplitude components other than the edge components, and hereby smoothes the input image data S1, conserving the edge components of the input image data S1." at column 2, line 58).

k is a filter coefficient (Refer to Figure 2, numeral 12a-"epsilon filter"),

f(t) is the input image ("input image data S1"),

1-k is a feedback rate (Refer to Figure 3,additionally, refer to Figure 14, for illustrations of multiple feedback responses at different rates throughout.),

and g(t-1) is the output from the recursive filtering means one-line before, and changes the feedback rate (1-k) on the basis of the magnitude of the difference (d) between the input image (f(t)) and the output value (g(t-1)) of the recursive filtering means one-line before ("The epsilon-filter 12A, which is a nonlinear smoothing filter,... it smoothes the image data S3,... and then sends the resulted smoothed image data S4A to an epsilon-filter 12B. In the case where the pixel for filter processing is one-dimensional and 2N+1 tap, the smoothing processing at this epsilon-filter 12A is represented with the following equation (Refer to equation 1). That is, the epsilon-filter 12A compares the absolute value absolute value of x(n) –x(n-k). of the difference between the pixel value x(n) of a central pixel p(n) and the pixel value x(n-k) of a pixel p(n-k) of

filter processing with the stated threshold value epsilon." at column 3, line 34) For further clarity, the multiple mathematical manipulations of these equations are found at column 3, lines 58-column 5, line 67).

Regarding Claim 10:

Tsuchiya discloses further comprising delay means of delaying the input image with respect to time processings (Refer to Figure 1, numeral 4-"Delay Circuit") performed by the processing means including the recursive filtering means (Refer to Figure 1, numeral 3-"Image Processing Circuit"), wherein the input image delayed by the delay means is input as the original of the image input to the arithmetic means (Refer to Figure 1, numerals S15-S17; additionally, the input image to be delayed is S1).

Claim Rejections - 35 USC § 103

5. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

6. Claims 4,5,7-9 and 11 are rejected under 35 U.S.C. 103(a) as being unpatentable over Tsuchiya et al (US 6,724,943 B2) in combination with Florent (US 6,15,1417)

Regarding Claim 4:

Tsuchiya discloses all the claimed elements as listed above.

Tsuchiya does not specifically disclose that the low-frequency component compression means has lookup table means supplied with an output value from the recursive filtering means and

converting the output value into a value obtained by multiplying the output value by a predetermined coefficient.

Florent teaches wherein the low-frequency component compression means (Refer to Figure 3a, numeral 24) has lookup table means (Refer to Figure 3a, numeral 27-"Lookup Table") supplied with an output value from the recursive filtering means and converting the output value into a value obtained by multiplying the output value by a predetermined coefficient ("...two-dimensional spatial filtering means (F(2D)) which are applied to said difference image in order to enhance spatially coherent samples and to supply a measure of probability of motion (beta(t)) which is linked to said spatially coherent samples,...means for applying a scalar function (f(1)) to said measure of probability of motion (beta(t)) to supply an output coefficient (alpha(t)) and...means for generating said recursion factor (K(t)) in dependence on said output coefficient (alpha(t))." at column 7, line 16).

At the time that the invention was made, it would have been obvious to one of ordinary skill in the art to incorporate a LUT where the low-frequency compression converts the output values into a value obtained by multiplication as taught by Florent with the application of compression as disclosed by Tsuchiya because "this application will enhance spatially coherent samples and will further supply a measure of probability of motion which is linked to said spatially coherent samples." (Florent at abstract).

Regarding Claim 5:

Florent teaches wherein the lookup table means changes the predetermined coefficient according to a catheter displayed in the input image ("The means 20 for generating K(t) include

calculation means 24 for applying a decreasing scalar function f(1) to the measure of probability of motion beta(t) (x,y) and for supplying a coefficient which is written as alpha(t)and formulated as (Refer to Equation 5)." at column 4, line 19-32. For clarity, alpha(t) is the coefficient and beta(t) is the probability of motion with reference to a catheter, optical fibers or the like.

Regarding Claim 7:

Tsuchiya discloses all of the claimed elements as listed above at claim 1.
Tsuchiya does not specifically disclose the recursive filtering means separately generate smoothed images with respect to edges in direction at 45 degree. from the scanning line direction of the input image (left-downward direction), a direction at 90 degree. from the scanning line direction (downward direction) and a direction at 135degree. from the scanning line direction (right-downward direction).

Florent teaches The image processing device according to claim 1, wherein the recursive filtering means separately generate smoothed images with respect to edges in direction at 45 degrees from the scanning line direction of the input image (left-downward direction), a direction at 90 degrees from the scanning line direction (downward direction) and a direction at 135.degree. from the scanning line direction (right-downward direction). ("Referring to FIG. 5A, said spatial filter 23 performs an oriented two-dimensional non-linear smoothing operation; to this end it includes a plurality N of linear operators which are formed by linear sub-filters F(1) . . . , F(N) which are arranged radially around a common point which is situated at one of their extremities and coincides with the point Q(t) (x,y) of the difference image A(t) to be filtered. The

sub-filters are regularly distributed in space along axes QZ1 to QZN which are spaced angles (2pi)/(N) apart." at column 4,line 62).

At the time that the invention was made, it would have been obvious to one of ordinary skill in the art to add together the process of separately generating smoothed images in a direction at 45 degrees, 90 degrees, and 135 degrees as taught by Florent with the recursive filtering process as disclosed by Tsuchiya because while using multiple directions to measure the smoothed edges of the image to be filtered, you will have "enhance[d] intensity of the spatially coherent samples in the difference image. Therefore, the bands of the difference image, being small coherent and oriented structures, are enhanced by the passage of the support of the sub-filter of the same orientation." (Florent, column 4).

Regarding Claim 8:

Florent teaches The image processing device according to claim 7, wherein weighting averaging is performed on the smoothed images separately generated with respect to the edges by the recursive filtering means ("The dimension of the supports of the sub-filters is W2 along the axes QZ1, . . . , QZN and W1 in the direction perpendicular to said axes, where W2>W1. For example, W1 equals 1 or 2 pixels and W2 equals from 5 to 10 pixels. The sub-filters form mean values with coefficients which are constant or decrease from the extreme point Q(t) (x,y). For example, N=8 directions suffice. At the point Q(t) (x,y) the sub-filters calculate a number N (for example, 8) of mean values which are referenced M(1) (Q), M(2) (Q), . . . , M(8)(Q)." at column 5, line 3).

Regarding Claim 9:

Tsuchiya discloses the recursive filtering means (Refer to Figure 1, numeral 5).
Tsuchiya does not specifically disclose generat[ing] the smoothed image by selecting the edge according to the direction in which a catheter displayed in the input image travels, however,

Florent teaches generat[ing] the smoothed image by selecting the edge according to the direction in which a catheter displayed in the input image travels ("It is an object of the present invention to propose an improved image processing system of this kind for filtering the noise in a sequence of images representing very small objects, such as catheters or optical fibers, without excluding image parts representing such very small objects in motion." at column 1, line 60).

At the time that the invention was made it would have been obvious to one of ordinary skill in the art to generate a smoothed image by selecting an edge according to the direction of a catheter as taught by Florent with the application of filtering and smoothing as taught by Tsuchiya because " [through] motion detection means [there] is a comparator which compares the intensity differences in the difference image with a noise threshold and signals the presence of a moving object when a difference in the difference image exceeds this threshold." (Florent, at column 1). This motion detection will provide the user with a stronger analysis for observation and analysis of the moving object, for example, the catheter.

Regarding Claim 11:

Tsuchiya discloses all the claimed elements listed above.

Tsuchiya does not specifically disclose a first line of memory in which the input is stored and he also doesn't specifically teach a second line memory in which the line data before storage in the first line memory is stored, however,

Florent discloses wherein the recursive filtering means (Refer to Figure 7, numeral 50) comprises:
a first line memory in which one line of the input image is stored (Refer to Figure 1b, numeral 15);
a second line memory in which line data before storage in the first line memory is stored (Refer to Figure 3b, numeral 26, specifically with the directional's of K(t) and K(t-1));
an arithmetic device which subtracts the line data stored in the first line memory from the line data stored in the second line memory ("In a version 120 the recursion factor K(t) is calculated in a simple manner, in the block 25, by way of a first function which is written as (note equation 6(a)), further reference lines 6-15, column 6);
lookup table means of converting the difference value obtained by subtraction performed by the arithmetic device into a value obtained by multiplying the difference value by a filter coefficient (Refer to Figure 3a, numeral 27-"Look-Up Table");
and an adder which adds together the value converted by the lookup table means as a result of multiplication by the filter coefficient and the line data stored in the second line memory (Refer to Figures 3a and 3b, numeral 22).

At the time that the invention was made, it would have been obvious to one of ordinary skill in the to add the first and second lines of memory as taught by Florent with the recursive filter image processing device as disclosed by Tsuchiya because for example, "the already

recursively temporally filtered sample Y(t-1) (x,y) originates from storage means or delay means MEM1 which are denoted by the reference 15. The recursive temporal filtering means 10 thus perform calculations in order to supply a filtered sample Y(t) (x,y). Additionally, the storage of these samples, enables elimination of the holes as well as the noise peaks such as S (t-1) as shown in FIG. 4B." at column 6, line 16-Florent).

Conclusion

7. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

US 6,466,700 B1 US 5,911,012 A US 5,768,405 A
US 7,170,635 B2

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Mia M. Thomas whose telephone number is 571-270-1583. The examiner can normally be reached on Monday-Friday 8:30am-5pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Vikkram Bali can be reached on 571-272-7415. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

Mia M Thomas
Examiner
Art Unit 2624

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